HONDURAS DISSERTATION/THESIS PROJECT

HON-M03 Lionfish as an invasive predator on Caribbean coral reefs

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Two species of lionfish (*Pterois volitans* and *Pterois miles*) that are native to the Indo-Pacific have become invasive in the western Atlantic, and more recently in the western Mediterranean. Invasive lionfish were first recorded off the coast of Florida in the 1980s and are now found along the east coast of North America, in the Caribbean Sea and Gulf of Mexico, and along the coast of South America. Lionfish invaded Honduras more recently, with the first individuals recorded in 2009.

Lionfish have proved to be the perfect invasive predator. Their hunting behaviour, which involves flaring their long and ornate pectoral fins, undulating the dorsal spines and occasionally blowing jets of water at prey, is unlike any other predator in the Caribbean. For this reason, native fish don't recognise lionfish as a predator, allowing lionfish to consume prey at much higher rates than native predators and has turned the Caribbean into an all you can eat buffet for these greedy predators. This in turn has led to large declines in native fish abundance, richness and recruitment across the invaded range. This has further knock on effects on the ecosystem as a whole, for example by removing herbivorous fish they reduce the amount of macroalgae that can be removed and so may contribute towards phase-shifts from coral-dominated to algal-dominated reefs. As well as prey naivety, lionfish also have no natural predators within their invaded range. Although there have been isolated cases of lionfish being preyed upon in the Caribbean by sharks, groupers, moral eels and even sea birds, in general predators seem not to target them, possibly because of their unusual shape and spines.

Lionfish are habitat generalists, able to occupy coral reefs, seagrass beds and mangrove forests as well as estuaries and man-made structures. They have even been observed on deep reefs down to over 300m depth, including 250m in Honduras on the island of Roatan. They are believed to undergo ontogenetic migrations, moving deeper as they mature, meaning the largest and most reproductively active individuals are often found below the reach of humans. Lionfish are also dietary generalists, meaning they consume a wide range of food sources. Although they are primarily predators, they will prey on most species and are only limited by what they can physically fit in their mouths. They will also consume invertebrates such as crustaceans, whilst algae has also been found in their stomachs. They are even known to resort to cannibalism, feeding on other lionfish where necessary! Finally, they demonstrate high fecundity, with a large female able to produce up to 2 million eggs every year. These eggs float to the surface where they can be dispersed on ocean currents, which is a key reason why they have been able to spread so quickly through the Caribbean.

Because of the negative effects that lionfish exert, and because they have no natural predators, they are currently managed by culling. Although complete eradication of lionfish in their invaded range is unlikely, studies have shown that local management efforts are effective at reducing lionfish density and allowing native species to recover. However, there are a few problems with current culling methods. Culling is mainly limited to shallow water (<30 m) due to the cost and training requirements of diving deeper (i.e. technical diving). Culling may also lead to lionfish being less

active and hiding deeper in the reef, making them more difficult to find. Lionfish traps are a possible alternative that will increase the depth limit of culling and reduce search times by divers, but these are only in the initial stages of development.

In recent years Operation Wallacea scientists have been studying the role of deeper reefs in lionfish ecology, and also their aggregating behaviour. Improving our understanding in these areas will have direct management benefits, as it will help to maximise the efficiency in which lionfish can be culled by local management strategies. As an example of how knowledge of their invasive ecology can be translated into management, Operation Wallacea's Honduras team are working with US-based charity Robots in Service of the Environment (RSE), who are developing an underwater robot capable of reaching depths of 200m. The robot is capably of stunning lionfish and capturing them to bring them back to the surface and offers the chance of targeting deeper populations which are out of reach for even the most advanced SCUBA divers.

Students on this project could focus on a number of areas for their own research projects. The team will likely be based at our site in Tela Bay, where we are generally the only people to dive the reef system and so lionfish culling can be carefully controlled. Data could include lionfish density surveys, which would involve searching for lionfish using SCUBA at a range of reef sites, which could be combined with observational recordings on their habitat associations and behaviour, such as their flight distance or aggressive response in response to divers, or their aggregating behaviour. Lionfish will then be culled and returned to land, where morphological measurements can be taken, such as length, gape size, spine length and weight. The fish can then be dissected to give additional data including gender, level of sexual maturity and fat content. Finally, gut content analysis can be performed to identify food sources, and this can be linked to the availability of different prey on the reefs where each fish was found. In addition, similar data would be available from previous years for any students wanting to incorporate a temporal element into their projects.

Recommended Reading

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